Eoanthropus, assigning this human form to the "latter half of the Pleistocene" and giving its cranial capacity as "at least 1070 c.c." Dr. Smith Woodward came to the conclusion that Eoanthropus belongs to the older Pleistocene, and in his more recent reconstruction of the skull represents the cranial capacity as 1300—230 c.c. above his original estimate.

Prof. Sollas sums up his final conclusion as regards human antiquity as follows: "that man, not only in the narrower, specific sense but also in the broader generic sense—Homo—is a product of the Pleistocene epoch, the latest child of time, born and cradled amongst those great revolutions of climate which have again and again so profoundly disturbed the equilibrium of the organic world." It will be seen from this extract that the author favours the older opinion that man made his first appearance at a comparatively recent date.

The Body in Health. By Prof. M. V. O'Shea and J. H. Kellogg. Pp. ix + 324. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1915.) Price 3*s.* 6*d.*

OF the making of books on elementary physiology and hygiene there seems to be no end, and the tendency to the multiplication of such manuals is specially marked in America. Perhaps this is an indication that our cousins across the sea are more alive to the importance of health in the well-being of a nation; they certainly make it a much more universal subject of school education than we do. The present volume has much to recommend it; it is clear, convincing and accurate; it is written in simple language and well illustrated; as a rule it is level-headed. The usual space, as in all American text-books of this kind, is devoted to the evil of alcohol; with that one has no quarrel; but tobacco also is regarded as nearly equally bad. The following is, for example, quoted with approval: "I know whereof I speak when I say that tobacco when habitually used by the young leads to a species of imbecility; that the juvenile smoker will lie, cheat and steal things he would not do had he let tobacco alone." Extravagant superlatives of this nature often do more harm than good.

W. D. H.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Ultra-Violet Excitation of the D Line of Sodium.

IN a letter on this subject published in NATURE, May 13, I showed that sodium vapour, stimulated by the second line of the principal series at wave-length 3303 in the ultra-violet, fluoresces with emission of the D line, which is the first member of the principal series.

Each of these lines is a doublet. The interesting question arises, Supposing that stimulation were confined to one member only of the ultra-violet doublet, should we get emission only of the corresponding member of the D line, or would both components of the D line be emitted? The first alternative seemed *a priori* more probable, taking into account the result of Wood and Dunoyer, that if sodium vapour is stimulated by D light, one component of the D line is not able to give rise to fluorescent emission of the other.

I have, however, succeeded in carrying out an experiment which seems to decide fairly conclusively in favour of the second alternative. The zinc arc spectrum shows an ultra-violet doublet very near the sodium doublet. My attention was directed to this by reading Prof. Wood's account of his earlier attempts on the problem. Direct comparison of the spectra showed that the zinc doublet lay inside the sodium doublet, but that while one of the zinc components was situated at about one-twentieth of an Ångström from one sodium component, and thus very nearly in coincidence, the other zinc component was four times as far from its sodium neighbour, and well clear of it.

A zinc vacuum arc in quartz was used to illuminate the sodium vapour bulb, interposing the filter mentioned in the former paper, for the suppression of visible light. With currents of three or four amperes nothing could be seen. Increasing the current to six amperes, a faint emission of D light was observed. It was as yet too faint for spectroscopic examination, but was identified by the absorption methods described in the former letter. At 15 amperes, the light was bright enough for a specially designed spectroscope, and showed *both components of the D line in about equal intensity.*

The current was increased in successive tests to about 100 amperes. These large currents were only kept on for two or three seconds so as to avoid destroying the lamp. For this short time the fluorescence was not inferior in intensity to the light of a moderately salted Bunsen flame, and the components of the D line were seen very bright. The intensity increases very rapidly with the current through the lamp. This is due partly, of course, to the greater brightness, but more to the broadening of the first zinc component, which makes it definitely overlap the first sodium component. Possibly at very large currents this cause may even bring the second zinc component on to the second sodium component, but plainly the first overlap must come in much sooner, for the interval to be bridged is four times less; and at the lowest current which brings out the D line brightly enough for examination, its components are approximately equal.

Wood's failure to get any D emission is probably to be explained by his not having used a heavy enough current through the zinc lamp to secure an overlap of the zinc and sodium lines.

R. J. STRUTT.

Imperial College of Science, South Kensington,
May 31.

On the Sealing of Electrical Conductors through Glass.

AT the present time there is great difficulty in obtaining soft glass with a comparatively high coefficient of expansion, suitable for sealing wires into glass tubes, bulbs, etc. The pre-war imported stocks of glass for this purpose are exhausted, and the recently published results of glass research committees do not contain formulas for its manufacture. About three years ago, Mr. George B. Burnside, of the natural philosophy department of the University of Glasgow, discovered a method of hermetically sealing electrical conductors through glass and other vitreous substances. The process is simple, and entirely obviates the use of a "flux" glass; and in view of the present needs, it seems advisable to bring this method again before the notice of those who may find it to their advantage to use it. A general description of the process appeared in the *Electrician* of July 4, 1913; but the method does not seem to have become so popular as might have been expected from the simplicity and ease of its application. As to the results obtained, the following facts from my own experience may be mentioned as affording proof of its absolute perfection.

In the course of some research work which is being carried on at present in Prof. Gray's laboratory, involving the examination of certain resolved spectral lines, a Wehnelt electrolytic interrupter was used in connection with an 18-in. induction coil. This interrupter was employed on account of the fact that, with it, the discharge can be allowed to run for hours without attention. The positive electrode was simply a small length of platinum wire sealed through the end of a glass tube. The wire conveying the current dipped into mercury surrounding the upper end of the sealed wire. At first the sealing of the platinum wire into the glass tube was done by means of a "flux" glass in the usual way. It was noticed, however, that after a few hours' working, as a result of the disruptive action of the interruptions, this glass round the anode became pitted out, a crater being formed with the wire projecting from its centre. This action may go on until a leak occurs. Again, for the large currents used—more than 10 amperes—a fairly heavy wire is necessary, and the heating effect frequently causes fracture of the glass, by small radial cracks starting from the wire, or even from the junction of the two glasses. Both these effects are, of course, undesirable. The pitting out of the glass exposes a greater amount of the conducting material, and consequently alters the frequency; while leakage due to fracture considerably increases the amount of "steady current," that is, current spent in mere ordinary electrolytic effects.

To overcome both these defects, I used a piece of Jena glass tubing, with a small length of heavy platinum wire sealed directly into it by the Burnside method. This anode has been in use now for several hours daily for the past five weeks, and there is neither any fracture nor any sign of the pitting out of the glass as formerly. This hard glass is less liable than the soft sealing-in glass to be damaged by the disruptive action of the current, and the chilling process has the effect of toughening the skin of the glass as well as of perfecting the seal between the glass and the wire.

In connection with the same research, a large number of small vacuum discharge tubes were required. In most of these tubes, the electrical conducting wire has been sealed in by the Burnside process, and in every case the result has been entirely satisfactory. The spectral lines under observation are of rather low intensity, and, in consequence, exposures of four or five hours' duration are required to give a good photographic presentment. Generally, each tube has been used for two photographs. Thus the discharge has been passed in one direction for four hours or more, continuously, and then in the opposite direction, for a similar continuous period of four or five hours. In many cases, during the process of exhaustion, the tubes have been strongly heated by means of a bunsen burner; during some of the exposures, when the vacuum has been high, the tube has become very hot; in some cases the discharge has fractured the glass near the discharge end of the kathode; but in no single case has cracking occurred at the seal, nor has there been any sign of leakage. Considering the large number of tubes used, I think these facts afford striking evidence of the trustworthiness of the seal.

The essential part of Mr. Burnside's process of sealing consists of the repeated immersion of the leading-in wire and the glass surrounding it, in a bath of oil, fat, or wax. If a wire is to be led into a tube, the tube should be drawn down until the bore is just large enough to admit the wire. The conductor having been inserted, the glass around it is strongly heated in the blow-pipe flame until perfect cohesion has taken place between the metal and the glass. The wire should then be drawn out slightly, carrying the adhering glass with it, and this glass heated again. This may be repeated until a "neck" of glass about two or three millimetres long, and having the end well rounded, is formed around the wire. The seal is then withdrawn from the flame, and, when the red glow has entirely disappeared, the end of the tube carrying the wire is cooled by several immersions in the oil. This may best be done by bringing the bath containing the oil—a short, wide test-tube, say—up round the seal. Each immersion should last about two or three seconds. The depth of immersion is increased with each successive dip, until the seal is completely cooled out. In the case of vacuum tubes where the electrode requires a small inner support tube, the conducting wire can first be fused into the support tube, leaving a fairly long thick neck of glass in contact with the wire. This support is then well fused into the bulb of the vacuum tube in the usual way, and, finally, the seal is cooled out as described above. Not only does this cooling process render perfect the seal between the metal and the glass, but it also improves the junction of the glass of the inner tube with that of the outer. The leading-in wire of one of the vacuum tubes, immediately after being cooled out in oil, has been suddenly heated in the blow-pipe flame until it was at a bright red heat up to within about 1 mm. from the glass, without the seal being affected.

Compared with previous methods of sealing in electrodes, where a special "flux" glass had to be used, where care had to be taken to prevent the ordinary glass of the tubes from coming directly into contact with the metal, and where, unless special precautions as to annealing were observed, fractures frequently ensued, the present method is much simpler and easier, and more effective. It also enables us to make discharge tubes of Jena or other hard combustion glass. This was formerly quite impossible on account of the fact that no "flux" was known which was suitable for sealing wires through glass of this nature.

Mr. Burnside recommends that sperm oil be used, and that it be heated slightly before the glass is immersed in it. For the above work, I used the ordinary machine oil from the workshop—simply because it was most readily obtainable—and used it at room temperature. In cases where the position of the seal prevents its being conveniently immersed in a bath of oil, the process may be effected by bringing vertically upwards a piece of fat or wax cut to a suitable size and shape, and pressing it against the hot seal.

It may be mentioned also, that not only can platinum be sealed directly through Jena or other hard resistance glasses, and through fused quartz, but that perfect seals may be made between the more easily oxidisable metals, such as copper or iron, as well as platinum, and glasses having comparatively low fusion points, *e.g.* lead glass and German glass, or any glass of this nature. For large currents the conductor should be tubular, because it can be more effectively cooled out by repeated immersions than would be the case if a solid conductor of the same cross-sectional area were employed.

The cases to which the process is applicable in scientific work are obvious and numerous, and it is needless to specify them. In view of the number of applications of a commercial and industrial value, as *e.g.* in the manufacture of incandescent electric lamps, mercury-vapour lamps, etc., the process has been protected by patent in Great Britain and abroad; but I understand that this protection is not intended to restrict in any way its use in research laboratories or its application to any purposes of a purely scientific and unremunerative nature. F. F. S. BRYSON.

Natural Philosophy Institute, University of Glasgow, May 24.

Eryonicus-Polycheles.

IN a recent publication on the Crustacea of Ireland, "Decapoda Reptantia of Ireland," Part I., by C. M. Selbie (Fisheries, Ireland, Sci. Invest., 1914, I. (1914)), the question of whether the peculiar forms known as Eryonicus are larvæ of the crayfish-like deep-sea crustaceans Polycheles is answered to the effect that they are independent animals constituting a genus related to Polycheles.

As these animals since the days of the *Challenger* Expedition have enjoyed a special interest as the modern survivors of a group almost until then believed to be confined to Jurassic and Cretaceous times, I thought it might possibly interest some of your zoologist readers to learn about some of the results obtained through the study of the material collected in the North Atlantic by the *Michael Sars* in 1910 during the cruise undertaken by the late Sir John Murray and Dr. Johan Hjort.

To begin with, it must be mentioned that the best specific characters both in Polycheles and Eryonicus are derived from the arrangement of the spines on the carapace. Now a peculiar correspondence is observed in several species of the two "genera," making it possible to "pair" several of the Eryonicus species each with one of the Polycheles species, as will be seen from the following formula representing the position of spines in the median line of the carapace. In these formulæ, 1 and 2 denote single and double *pointed* spines, while 3 denotes a single *blunt* spine, and *c* the position of the cervical groove, the rostral spines being to the left:—

E. faxoni, Bouvier	2.1.2.1.3.*c*.2.2.3.2	*a*
P. sculptus, Smith	2.1.2.1. *c*.2.2. 2	
E. coecus, Faxon	2.1.2.1.1[1].*c*.2.2.1[1].2	*b*
P. sculptus pacificus, Faxon	2.1.2.1. *c*.2.2. 2	

The two species *a* live in the Atlantic, the species *b* in the Pacific. The only difference between the two pairs consists in *b* having a spine on the cardiac area on each side, this spine being absent in all specimens of *a* examined by Mr. Selbie and myself:—

E. hibernicus, Selbie... ...	2.1.1.2.3.1.*c*.2.2.3.2	*c*
P. nanus, Smith...	2.1.1.2. 1.*c*.2.2. 2	
E. spinulosus, Faxon ...	2.1.1.1.2.1[1].1[1].*c*.2.2.1[1].2	*d*
P. tanneri, Faxon	2.1.1.1.2. *c*.2.2. 2	
E. kempi, Selbie...	1.1.1.1.2.1. *c*.2.2.3.2	*e*
P. typhlops, Heller	1.1.1.1.2.(2)*c*.(2).(2). 2	

The figures within brackets in the formula for *P. typhlops* denote that these spines in some of Mr. Selbie's specimens were of reduced size, single, or wholly rudimentary. It will be noted that the spines known or supposed to be blunt have no equivalent in the corresponding Polycheles.

Now, I ask, is it possible to explain the above correspondences as mere accident, or are they not to be taken as evidence of the Eryonicus species being in fact larval Polycheles?

One of the commonest objections to this theory is the giant size presented by some of the Eryonicus-specimens compared with the smaller Polycheles-individuals, though this need not signify much. Like so many other plankton animals, the Eryonicus are of a nearly jellyfish-like consistency, and it may as well be conceived that an Eryonicus can shrink into a small Polycheles, as that the Leptocephali, when turning into "montée," lose about 78 per cent. in weight (in dry matter they lose over 32 per cent.), according to Dr. Johs. Schmidt, the Danish specialist on eels.

If Eryonicus were adult animals, it would be rather remarkable that not a single egg-bearing female has been found among the fifty-nine specimens known to have been captured (Mr. Selbie, *op. cit.*, mentions thirty-five specimens, and the *Michael Sars* got twenty-four). It cannot matter much that secondary male sexual characters in different stages of development have been found in a few of the largest specimens.

Finally, it must be mentioned that one is at a loss where to seek the larvæ of Polycheles, which do not seem to be very rare animals (the Irish research steamer *Helga*, for instance, obtained thirty-two specimens) if these larvæ are not represented by Eryonicus.

For literature and details of the species in question, see Mr. Selbie's paper quoted above.

OSCAR SUND.

Bureau of Fisheries, Bergen, Norway, May 8.

The Age of the Earth.

IN NATURE of May 6, Mr. C. E. Stromeyer states that two conclusions in my letter published in your issue of April 22 are not correct; he claims, first, that the amount of energy lost by the earth is not compensated by the heat received from the sun; secondly, that meteoric bombardment of the sun has been left out of account as a source of energy.

As to the first point, the amount of energy lost in consequence of the temperature gradient in the earth's crust is of the order $1{\cdot}33 \times 10^{-6} \frac{\text{cal}}{\text{cm.}^2\text{sec.}}$. As this is 6000 times less than the total amount radiated, no useful purpose would be served by taking it into account.

As regards the second point, any heat due to meteoric bombardment up to date has been taken into account, as the sun's mass as it is known to-day was inserted in the calculation.

Perhaps the purport of my letter was not as clear as I could have wished. It was not so much my intention to weigh the evidence for or against an age of some twenty million years, as to emphasise the point that neither radio-activity nor any other known cause will account for a longer period. I have lately had the advantage of discussing the subject with Prof. Strutt, and must admit that the conclusions he has drawn from the helium contained in rocks appear unanswerable.

It would seem, therefore, that the origin of the sun's heat cannot be referred to any known cause.

Farnborough, May 15. F. A. LINDEMANN.

Modern Substitutes for Butter.

THE issue of NATURE dated April 8 contains an article relating to "Modern Substitutes for Butter," which gives a highly interesting impression of the technical and scientific state to which the margarine industry has developed in recent years.

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[1] These spines are represented by Faxon as being pointed. I believe from analogy with all the Irish and *Michael Sars* specimens that they are in fact blunt.